Equity of access to critical care among elderly patients in Scotland: a national cohort study

ONLINE DATA SUPPLEMENT COVER SHEET

Manuscript Title

The elderly in Scottish Intensive Care Units: is there equity of treatment?

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SUPPLEMENTARY METHODS

Inclusion criteria were patients resident in Scotland aged 16 or older whose first admission to general ICUs and combined units occurred between 1st January 2005 and 31st December 2009. Exclusion criteria were ICU records without valid linkage to the Scottish national databases or unknown healthboard of residence. Patients transferred between ICUs were counted as one admission, with the admission date taken from the first unit, and discharge date from the last unit.

Setting

Configuration of Critical Care services in Scotland

Between 2005-2009, SICSAG collected data on all admissions to all 23 general Intensive Care Units (ICU) and Combined Units (units with a combination of ICU and High Dependency Unit (HDU) beds). During the study period, specialist neurosurgical and cardiothoracic ICUs were not included, nor were standalone HDUs. The organisational set-up differed between healthboards.

Variables

Comorbidities

These were derived from the APACHE II (Knaus et al., 1985) comorbidities (severe cardiovascular disease, severe respiratory disease, severe liver disease, immunosuppression, end stage renal disease and metastatic cancer) and the seventeen comorbidities used in the Charlson comorbidity list[E1] recorded in SMR01. The APACHE II comorbidities were entered by ICU staff at the time of admission to ICU. The Charlson comorbidities were derived from a one year "look-back" period from the date of the hospital admission during which the index ICU admission occurred using published ICD coding algorithms (Quan et al., 2005). The comorbidity categories were combined to produce 20 comorbid categories. These were

combined into eight binary categories to define comorbidity by system (cardiovascular, respiratory etc).

Socioeconomic status

Socioeconomic status was measured using the Scottish Index of Multiple Deprivation (SIMD) 2009[E2]. SIMD is an area-based ranking measure of relative deprivation across Scotland and was used in analyses as quintiles (1: least deprived, 5: most deprived).

Acute Physiological Score

Age is a key component of the APACHE II risk prediction model which confounds the comparison of severity of illness between elderly and younger patients. We therefore derived the Acute Physiology Score (APS) by subtracting age points and chronic health/admission type points from the APACHE score, which we used when comparing age bands.

Organ support

Organ support was defined as the presence or absence of invasive mechanical ventilation, inotropic/vasopressor therapy (this includes the use of dopamine, though its use is minimal in Scotland), and renal replacement therapy at any time point during ICU stay. This was reported as a binary variable. A count of numbers of organs supported was also calculated. Organ support duration was calculated as the number of calendar days the patient received organ support

Statistical analysis

Incidence of admission

Incidence of admission of elderly patients to ICU was calculated by dividing the number of patients ≥80yrs admitted by the mid-point estimate of the Scottish population ≥80yrs for each year, obtained from the National Records of Scotland. Direct standardisation was performed for sex and deprivation using the elderly standard Scottish population (the mean population

≥80yrs between 2005-2009). This process was duplicated for the younger age group admission incidence, using the mean population 16-65 between 2005-2009

Subgroups

Emergency abdominal surgery diagnosis was defined by a combination of "Type of admission" = "Emergency Surgery" + any of the following APACHE diagnoses: GI bleed, GI infection/diverticulitis, GI ischaemia, GI neoplasm, GI obstruction, GI perforation/rupture, GI surgery. Pneumonia diagnosis was derived directly from APACHE diagnostic categories.

References

1. Charlson, M., Pompei, P., KL, A. & MacKenzie, C. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chron Dis* **40,** 373–383 (1987).
2. National Statistics, *Scottish Index of Multiple Deprivation: 2009 General Report*. 2009, Scottish Government National Statistics Publications: Edinburgh.

SUPPLEMENTARY TABLES AND FIGURES

Table E1: Number of Intensive Care beds and occupancy rates per healthboard 2005-2009

Healthboard	**No. of Level 2/3 beds**	**bed occupancy (%)**
Ayrshire & Arran	12.2	72.8
Borders	5.6	56.6
Dumfries & Galloway	4.0	81.9
Fife	9.9	74.1
Forth Valley	9.6	78.6
Grampian	13.9	71.7
Greater Glasgow and Clyde	43.6	74.5
Highlands & Islands	7.4	76.3
Lanarkshire	22.2	79.2
Lothian	34.6	76.4
Tayside	10.4	70.4

Table E2: Comorbidities (combined APACHE and Charlson-defined) by organ system in the elderly, older and younger groups

	Total	%	<65	%	65-79	%	≥80	%
Co-morbidities								
Respiratory	3537	8.8	1564	7.0	1657	11.9	316	8.2
Cardiovascular	3267	8.1	905	4.0	1810	13.0	552	14.3
Malignancy	3196	8.0	1428	6.4	1480	10.6	288	7.5
Renal disease	1163	2.9	536	2.4	487	3.5	140	3.6
Hepatic	2066	5.1	1663	7.4	370	2.7	33	0.9
Cerebrovascular	597	1.5	218	1.0	300	2.2	79	2.0
Dementia	68	0.2	7.0	0.0	31	0.2	30	0.8
Diabetes	1743	4.3	871	3.9	734	5.3	138	3.6

Table E3: Presence and duration of organ support and ICU length of stay stratified by age. *Chi^2 test-for-trend.

	<65	%	65-79	%	≥80	%	p-value
Presence of Organ Support							
Mechanical ventilation Day 1 n(%)	14496	65.2	8324	60.5	2077	55.0	<0.001
Inotropes n(%)	8609	38.7	6867	49.9	1814	48.0	<0.001
RRT n(%)	2514	11.3	1987	14.4	339	8.9	<0.001
Max number of organs supported n(%) Whole cohort							0.01*
0	6118	27.5	3837	27.6	1226	32.2	
1	8386	37.7	4084	29.4	1156	30.4	
2	5960	26.8	4441	31.9	1192	31.3	
3	1771	8.0	1404	10.1	230	6.0	
Max number of organs supported n(%) Restricted to those ventilated on day 1							<0.001 *
Total n for MV day 1 subgroup	14496		8324		2077		
1	7162	49.4	2836	34.1	723	34.8	
2	5563	38.4	4084	49.1	1124	54.1	
3	1771	12.2	1404	16.8	230	11.1	
Duration of Support							
MV med (1st,3rd,max quartiles)	1 (0,4,303)		2 (1,6,284)		1 (0,2,46)		<0.001
Survivors	1 (0,3,303)		2 (1,6,250)		0 (0,2,45)		<0.001
Non survivors	3 (1,6,136)		3 (2,7,284)		2 (1,4,46)		<0.001
Inotrope med (1st,3rd,max quartiles)	0 (0,2,70)		1 (0,3,58)		0 (0,2,27)		<0.001
Survivors	0 (0,1,63)		1 (0,3,36)		0 (0,1,19)		<0.001
Non survivors	2 (1,4,70)		2 (1,4,58)		2 (1,3,27)		<0.001
RRT med (1st,3rd,max quartiles)	0 (0,0,58)		0 (0,0,48)		0 (0,0,23)		<0.001
Survivors	0 (0,0,124)		0 (0,0,38)		0 (0,0,23)		<0.001
Non survivors	0 (0,1,58)		0 (0,1,48)		0 (0,0,21)		<0.001
ICU LOS (1st,3rd,max quartiles)	2.0 (0.9,5.3,339.6)		2.9 (1.1, 7.8, 284.8)		1.9 (0.9,3.8, 57.9)		<0.001
Survivors	2.0 (0.9,5.2,339.5)		3.1 (1.5,8.1,263.0)		1.9 (0.9,3.7,50.9)		<0.001
Non-survivors	1.9 (0.7,5.9,134.5)		2.0 (0.7,6.8,284.8)		1.6 (0.5,4.8, 57.9)		0.023

Table E4: Subgroup analysis: no recorded comorbidities. Organ support and outcomes for patients admitted with pneumonia or emergency abdominal surgery restricted to those with no recorded comorbidities and receiving mechanical ventilation. Odds ratios reference category (REF) <65yr "Younger" group. Adjusted for the following confounders: sex, socioeconomic status, number of admissions in the past year, admission from non-home residence, acute physiology score.

	<65y	%	65-79	%	≥80	%	p value
Pneumonia							
n	1219		736		183		
RRT n(%)	252	20.7	167	22.7	24	13.1	0.014
Adj OR (95% CI)	REF		1.18 (0.92, 1.50) p=0.190		0.53 (0.59, 0.94) p=0.010		
CV support n(%)	810	66.4	538	73.1	146	79.8	0.051
Adj OR (95% CI)	REF		1.33 (1.07, 1.67) p=0.012		1.92 (1.26, 3.01) p=0.003		
ICU mortality n(%)	297	24.4	298	40.5	109	59.6	<0.001
Adj OR (95% CI)	REF		2.29 (1.84, 2.86) p<0.001		5.02 (3.50, 7.25) p<0.001		
1 year mortality n(%)	400	32.8	410	55.7	146	79.8	<0.001
Adj OR (95% CI)	REF		2.87 (2.33, 3.53) p<0.001		8.28 (5.54, 12.65) p<0.001		
Emergency abdominal surgery							
n	1176		1315		587		
RRT n(%)	127	10.8	192	14.6	52	8.9	<0.001
Adj OR (95% CI)	REF		1.31 (0.99, 1.75) p=0.057		0.89 (0.61, 1.30) p=0.558		
CV support n(%)	592	50.3	862	65.6	358	61.0	<0.001
Adj OR (95% CI)	REF		1.98 (1.64, 2.40) p<0.001		1.58 (1.25, 2.00) p<0.001		
ICU mortality n(%) **Adj OR (95% CI)**	128	10.9	263	20.0	131	22.3	<0.001
	REF		2.22 (1.68, 2.97) p=0.002		3.09 (2.21, 4.31) p<0.001		
1 year mortality n(%)	243	20.7	532	40.5	320	54.5	<0.001
Adj OR (95% CI)	REF		2.68 (2.18, 3.32) p<0.001		5.66 (4.40, 7.29) p<0.001		

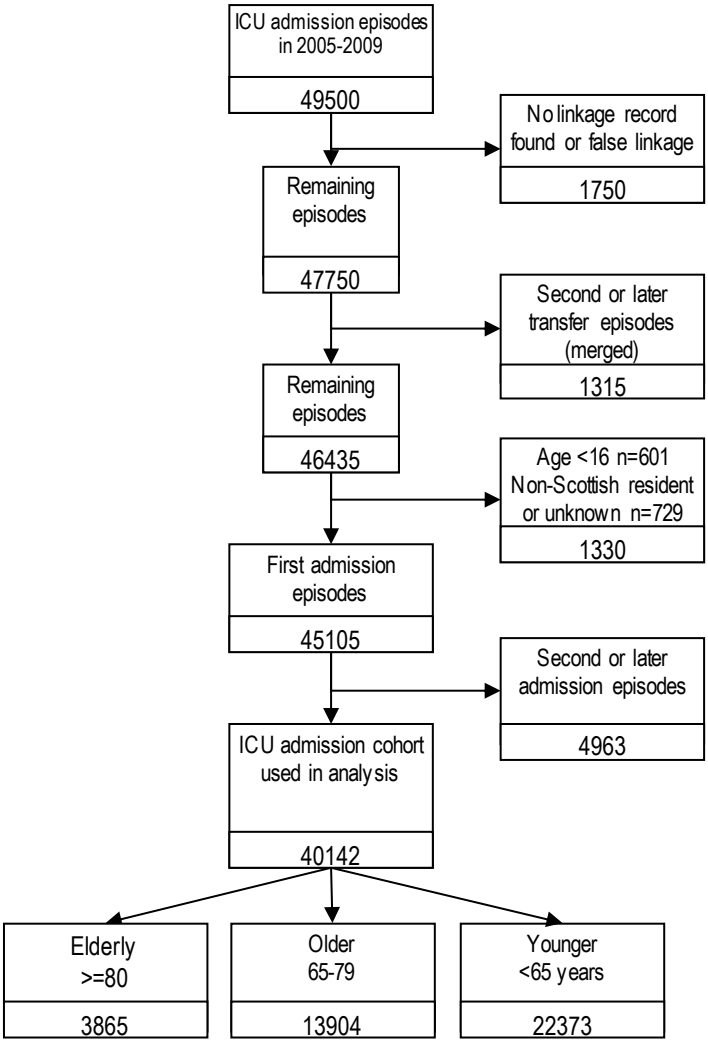

Figure E1: Consort diagram

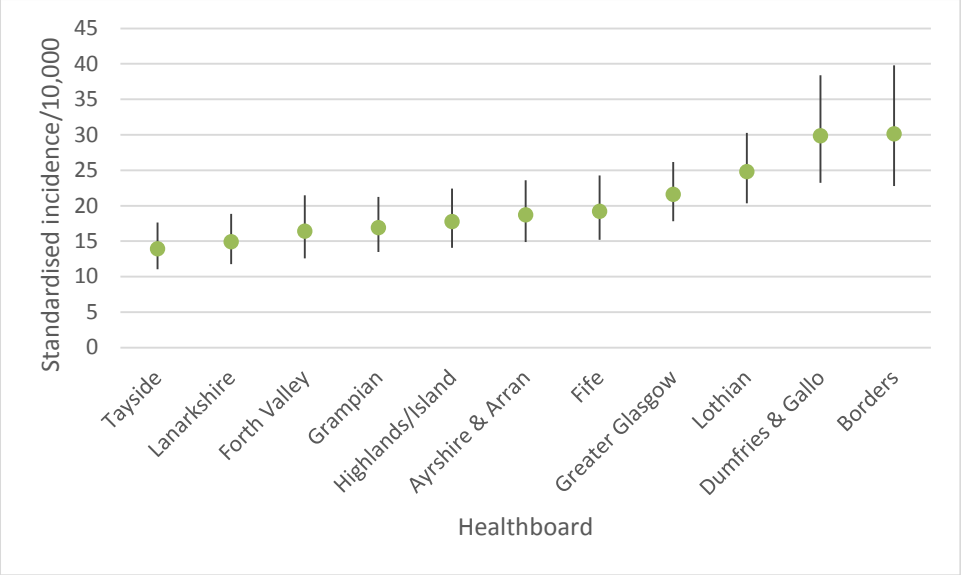

Figure E2: Incidence of elderly patients mechanically ventilated on day 1 of ICU admission/10,000 elderly Scottish population standardized for sex and socioeconomic status for each healthboard (2005-09). Incidence with 95% CI. Differences between healthboards $p<0.001$, χ^2 92.2, df 10.